

ILRS Station Reporting

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Abstract. *Network stations provided system configuration documentation upon joining the ILRS. This information, found in the various site and system log files available on the ILRS website, is essential to the ILRS analysis centers, combination centers, and general user community. Therefore, it is imperative that the station personnel inform the ILRS community in a timely fashion when changes to the system occur. This poster provides some information about the various documentation that must be maintained.*

Introduction

The ILRS network consists of over fifty global sites actively ranging to over sixty satellites as well as five lunar reflectors. Information about these stations are available on the ILRS website (<http://ilrs.gsfc.nasa.gov/network/stations/index.html>). The ILRS Analysis Centers must have current information about the stations and their system configuration in order to use their data in generation of derived products. However, not all information available on the ILRS website is as up-to-date as necessary for correct analysis of their data.

The Problem: System Changes

Stations perform upgrades and routine maintenance. Many of these upgrades improve performance of the station and the network as a whole, and thus improve the resulting data and derived products. However, these changes can also introduce biases in the data, which may take some time to detect. These biases can corrupt the derived products generated by the ILRS Analysis Centers as well as those products developed through combination with other techniques.

Examples (without naming the guilty parties):

- Problem: Station personnel initiated (or completed) a system upgrade without notifying the ILRS Central Bureau. The possible effects on the data from the upgrade are unclear. Result: Data taken following the upgrade are included in the operational data flow and in the resulting analyzed product. Systematic effects of the upgrade may degrade ILRS data products.
- Problem: The above station upgrade resulted in a significant change in the system configuration, thus requiring an updated SOD. Result: The lack of prior coordination with the ILRS Central Bureau results in the data being ignored by the ILRS Analysis Centers since their processing will look for “authorized” SODs in the data. Furthermore, in some cases, the Operations Centers have the same problem and data are withheld from the operational data flow.

- Problem: Station staff performed kHz system upgrades. The significant change was not announced and the ILRS site logs (main log and system configuration log) were not updated.
 Result: The ILRS Analysis Centers were unaware that the station data must be handled differently, particularly in terms of the applied target signature correction (e.g., a center-of-mass offset). Therefore, the data (incorrectly) appeared to be biased.
- Problem: Station personnel began (or completed) a system upgrade without notifying the ILRS Central Bureau. The possible effects on the data from the upgrade are unclear.
 Result: Data taken following the upgrade are included in the operational data flow and in the resulting analyzed product. Systematic effects of the upgrade may have degraded ILRS data products.

An example of the affect of unreported station changes in the data analysis is shown in Figure 1.

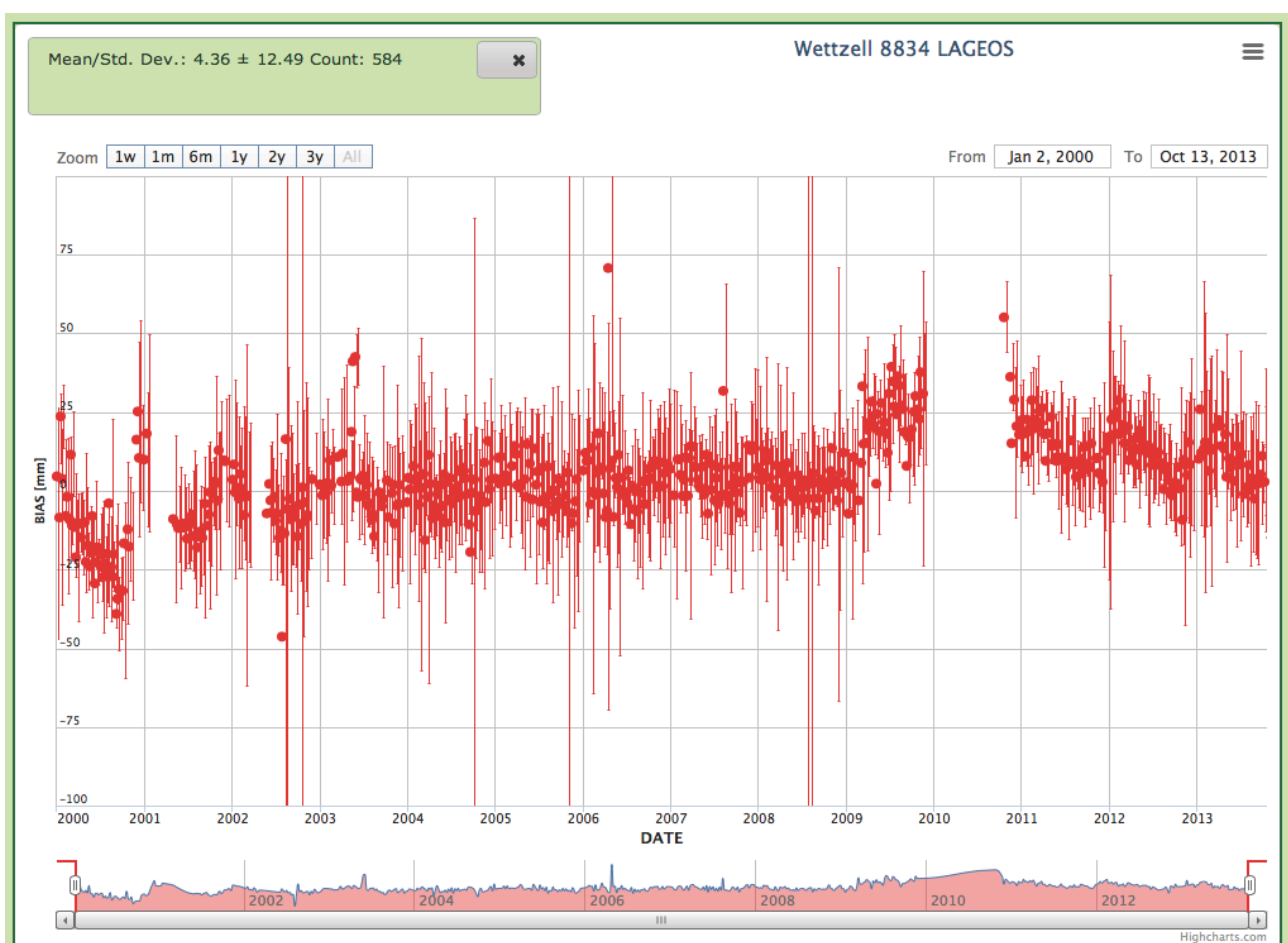


Figure 1. This plot shows the bias recovered from data tainted by a system hardware change. The plot illustrates problems seen by the ILRS Analysis Centers when data are released following a hardware change at the station. A persistent bias problem was detected during routine analysis. After contacting the station staff, it was found that the system detector was replaced. The Analysis Centers were instructed to allow for a bias when analyzing the data during the period in question and the station was removed from the list of “core” sites used by the ILRS Combination Centers. (plot courtesy of Erricos Pavlis).

The Solution: Notify and Document

When a station in the ILRS network makes a significant change to the hardware or software in the system's measurement path or software that is in the data processing chain, the station must undergo a "data validation" process in order to assess the quality of its data and to insure that the overall performance of the station meets the ILRS standards. Note that "measurement path" includes, but may not be limited to, the telescope, telescope mount, telescope pad, optics, transmit and receive paths, transmit and receive electronics, laser, detector, timing equipment, calibration piers or internal calibration path, meteorological sensors, software controlling any of these systems, as well as fixed geometric and electronic delays. The station must follow procedures and work with the ILRS Central Bureau to insure that the quality of the data has not suffered and that there have been no unexpected biases or systematic effects introduced into the data produced after the changes have gone into effect. ILRS station personnel should follow the procedures outlined on the ILRS website at: http://ilrs.gsfc.nasa.gov/network/site_procedures/index.html. The Central Bureau maintains a list of station upgrades on the ILRS website at:

http://ilrs.gsfc.nasa.gov/network/site_procedures/station_upgrade_status.html.

Station personnel should adhere to the following steps to ensure that system upgrades and modifications are documented properly and the community is informed in a timely fashion.

Step 1: Contact the ILRS Central Bureau:

- Notify the ILRS Central Bureau of the changes that will be/have been made to the station by sending an e-mail to ilrs-cb@lists.nasa.gov
- CB staff will review the proposed changes and inform station personnel if IDs (e.g., occupation designator) require update, if the data obtained after the upgrade requires quarantine, or if further action needs to be taken.

Step 2: Update the station's ILRS Site Log:

- Retrieve the EXISTING station Site Log (please do not upload a local copy) from: <ftp://cddis.gsfc.nasa.gov/reports/slrlog>
- Insert updated or new information / data into each field. Entries into the fields of the form are to be made after each colon, allowing 1 blank space following the colon. Responses can be in either upper or lower case or a combination. Fields with a fixed length or standard format will be indicated. Please follow the exact format as indicated. Some fields can expand over several lines. Most sections or subsections contain information that may change with time. Therefore, these sections contain the start and end date, date of installation and removal or first and last applicable date.
- Submit all completed and updated Site Logs to ILRS the Central Bureau at the following e-mail address: ilrs-cb@lists.nasa.gov
- The procedures for updating the site log are documented on the ILRS website at: http://ilrs.gsfc.nasa.gov/network/site_procedures/site_logs.html

An example ILRS Site Log is shown in Figure 2.

Step 3: Update the ILRS station Site Configuration Log:

- Retrieve the stations EXISTING Site Configuration Log (please do not upload a local copy) from: <ftp://cddis.gsfc.nasa.gov/reports/slrlog/slrhst>
- The procedures for updating the site configuration log are document on the ILRS website at: http://ilrs.gsfc.nasa.gov/stations/site_procedures/configuration_files/index.html

An example ILRS Site Configuration Log is shown below in Figure 3.

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ILRS Site and System Information Form
International Laser Ranging Service

0. Form

Prepared by (Full Name)      : Thomas Varghese
Preparer E-mail              : Tom.Varghese.Contractor@exelisinc.com
Date Prepared                 : 2013-06-21
Report Type                   : UPDATE
Format Version                : 1.0

1. Identification of the Ranging System Reference Point (SRP)

Site Name                     : Goddard Geophysical Astronomical Observatory
IERS DOMES Number            : 40451M105
CDF Pad ID                    : 7105
Subnetwork                    : NASA
Description                    : MONUMENT
Monument Description          : STANDARD NASA DISK
Monument Inscription          : 7105-1981
Mark Description              : Chiseled Cross
Date Installed                : 1981-03-01
Date Removed                  : (yyyy-mm-dd)
Geologic Characteristic       : CRETACEOUS SAND AND GRAVEL
Additional Information         : (multiple lines)

2. Site Location Information

City or Town                  : Greenbelt
State or Province             : Maryland
Country                       : USA
Tectonic Plate                : North American
Approximate Position
  X coordinate                 [m]: 1130719.512
  Y coordinate                 [m]: -4831350.574
  Z coordinate                 [m]: 3994106.56
  Latitude                     [deg]: 39.0206 N
  Longitude                    [deg]: 76.82770 W
  Elevation                    [m]: 19.184
  Additional Information        : (multiple lines)
                                .
                                .
                                .

17. More Information

URL for More Information      : http://cddis.gsfc.nasa.gov/ggao/index.html
Hardcopy on File
  Site Map                    : YES
  Site Diagram                 : YES
  Horizon Mask                 : YES
  Monument Description         : YES
  Site Pictures                 : YES
  Additional Information        : contact David McCormick
                                : more information at
                                : David.R.McCormick@nasa.gov

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Figure 2. An example of an ILRS Site Log for the MOBLAS-7 system at Greenbelt MD.

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% YYYY - Year
% DDD - Day of Year
% HH:MM - Time of Day (UTC) when change becomes active % F - Estimated Chance of Data impact Flag: 0=none; 1=maybe, but negligible;
% 2=slight influence possible; 3=YES, needs quarantine and verification by the ILRS.
% xx[.xx[.xx]] - Subsystem: enter the subsystem number from the site log,
% e.g. "12.01" for pressure sensor.
% Use 99 for those subsystems not mentioned in the site log, e.g. computers,
% software, multiple sub-systems.
% Text - Description of the change. This must be meaningful to the station personnel,
% so that more information can be made available to analysts if needed
%
% Remember to send this file to ILRS (edc@dgfi.badw.de) after each update
71050725 2011 111 09:22 2 99 Installed Counter
71050725 2011 115 06:12 2 09.01 Changed XL-DC antenna
71050725 2011 119 01:41 2 99 Counter G78777 installed
71050725 2011 124 11:35 2 99 Counter G71283 installed
71050725 2011 130 08:55 2 99 Counter G78793 installed
71050725 2011 136 12:17 2 99 Counter G78769 installed
71050725 2011 140 10:18 2 99 Counter G78768 installed
71050725 2011 141 09:20 2 99 Counter G71279 installed
71050725 2011 153 02:10 2 99 Counter G78769 installed
71050725 2012 044 04:16 2 99 Low loss cable changed
71050725 2012 068 06:20 2 99 Counter G78762 installed
71050725 2012 069 04:30 2 99 Counter G77376 installed
71050725 2012 082 05:15 2 99 Counter G71204 installed
71050725 2012 089 03:57 2 99 Counter G71203 installed
71050725 2012 096 04:12 2 99 Counter G78409 installed
71050725 2012 101 05:28 2 99 Counter return to original configuration
71050725 2012 347 10:10 2 09.01 XL - DC G000271 was installed
71050725 2013 022 08:05 2 99 Installed 5370B counter G78768
71050725 2013 115 04:06 2 99 Installed 5370B counter G78769

```

Figure 3. An example of an ILRS Site Configuration Log for the MOBLAS-7 system at Greenbelt MD.

Step 4: Update the system configuration records (C-series) in the CRD-formatted data:

- The CRD format description is available on the ILRS website at: http://ilrs.gsfc.nasa.gov/docs/crd_v1.01.pdf

An example of the system configuration records in the CRD format is shown in Figure 4.

```
h1 CRD 1 2013 9 9 9
h2 GODL 7105 7 25 3
h3 lageos1 7603901 1155 -1 0 1
h4 1 2013 9 9 4 6 14 2013 9 9 4 39 33 0 0 0 0 1 0 2 0
c0 0 532.000 std lal mcp til
c1 0 lal Nd:Yag 532.000 5.00 100.00 150.0 15.00 1
c2 0 mcp MCP-PMT 532.000 12.0 2800.0 31.0 analog 400.0 1.00 80.0 30.00 none
c3 0 til Truetime_XLDC Truetime_XLDC HP5370B na -1.0
60 std 4 1
40 14774.402617600001 0 std -1 -1 -1.000 97414.0 -2.0 25.0 -1.000 -1.000 -1.0 2 2 0
20 14850.203 1011.50 294.70 51. 0
11 14850.202619000000 0.056392337308 std 2 120.0 4 59.0 -0.552 -1.291 -1.0 0.67 0
20 14964.803 1011.50 294.70 51. 0
11 14964.802618800000 0.054416363667 std 2 120.0 56 67.0 0.210 0.126 -1.0 9.33 0
20 15041.603 1011.60 294.50 51. 0
11 15041.602618800000 0.053146761581 std 2 120.0 53 74.0 0.250 -0.265 -1.0 8.83 0
.
.
.
20 16749.003 1011.80 293.90 51. 0
11 16749.002620200001 0.046909640528 std 2 120.0 31 83.0 0.343 -0.319 -1.0 5.17 0
50 std 70.5 0.121 2.945 -1.0 0
h8
```

Figure 4. An example of the System Configuration Records (C-series) in the CRD-formatted data for the MOB LAS-7 system at Greenbelt MD.

Concluding Remarks

In order to provide the best data products for our users, field stations must keep the Central Bureau and the analysts fully up to data on systems status and configuration changes. The benefits of our technology and the concerted efforts of ranging operations can be degraded or lost when systems information is incomplete or not current.